Creating the Integrated Information Infrastructure for the 21st Century at the University of Washington Warren G. Magnuson Health Sciences Center

Sherrilynne Fuller, Ph.D.
Coordinator, Health Sciences Information Systems Integration
University of Washington, Seattle, WA 98195

ABSTRACT

Successful integrated information systems implementation requires an effective marriage of technology and information resources in response to critical institutional needs. The University of Washington technical infrastructure, developed over the past five years, includes ubiquitous, high-speed network access throughout the Health Sciences Center and hospitals, agreement on network standards and protocols, uniform interface to common databases (character-based and GUI) and network availability of a variety of databases and information resources at no charge to the individual. As a result of this heavy institutional investment in technical infrastructure, our implementation process will focus on expanding the number of available resources as well as developing and refining tools and services to enhance the utility of electronic information resources. Above all we will study and develop strategies for dealing with the myriad of information policy issues which confront and confound us all today.

PLANNING PROCESS

The National Library of Medicine's IAIMS (Integrated Advanced Information Management Systems) program is over ten years old. [1, 2] A number of institutions have undertaken planning processes. [3, 4] A few have gone on to full-scale implementation. [5, 6, 7, 8] The University of Washington has recently completed a three-year planning process and is preparing to embark upon broad implementation of our plan.

As a result of our relatively late entry into IAIMS planning, we have been able to learn from the experiences of other health sciences centers and to leverage our existing institutional efforts. Our planning process, which was funded by the National Library of Medicine in 1990, has involved the entire health sciences center, including the Schools of Medicine, Nursing, Dentistry, Pharmacy, Public Health and Community Medicine and Social Work as well as University of Washington Medical Center and Harborview Medical Center. Key faculty and administrators from throughout the Health Sciences Center have contributed to the process in which no single school or program dominates.

The hallmarks of our planning process include: careful study of the UW institutional environment and its needs; utilization of the experiences of other IAIMS institutions; broad faculty, librarian and administrator participation; an intensive educational process; and a focus on people instead of technology. A more detailed view of our planning process can be found in Fuller, 1992 [9].

TECHNICAL INFRASTRUCTURE

In parallel with our planning process we have been developing the technical infrastructure to support our long-range plans. Vital to our IAIMS implementation process is the presence of a state-of-the-art, University-wide information infrastructure which permits us to concentrate on the creation of value-added health sciences information integration programs and services. All health sciences buildings are connected via fiber to the central backbone. The following network technology standards are the norm: ethernet connectivity via 1-Mbps ethernet, TCP/IP protocol suite, authentication via Kerberos. UNIX is the operating system of choice for multi-user systems and shared servers because of its openness, flexibility and rich networking capabilities. Client-server computing is the predominant approach for the long-term development of systems.

Four general types of desktop computing environments are supported: PC, Macintosh, UNIX workstation and X-terminal. The majority of faculty in the health sciences center have access to devices connected to the campus network. Applications available on campus include character-oriented as

0195-4210/92/$5.00

well as graphical. PINE, a very user-friendly UNIX e-mail package developed at UW, is used by the majority of faculty, staff and students. The method for supporting departmental and campus-wide electronic mail services is based on the client-server mail protocol IMAP.

UWIN (University of Washington Information Navigator) is a character-based, campus-wide information system. It is designed to be a central point for distribution of information for and about the University community, allowing use of networked resources both on and off campus. UWIN provides a deeper level of support than a pure pointer system. General desktop reference tools such as Grolier's Encyclopedia, Oxford English Dictionary, Clarinet New Service and campus events calendar are available as are local reference databases including MEDLINE, PsychINFO, INSPEC and the Library's online catalog. UWIN also serves as a software license manager.

WILLOW (Washington-Information Looker-Upper Layered over Windows) is our X-Windows graphical user interface to a variety of bibliographic and full-text databases. [10] WILLOW development was initiated by and continues to be led by Health Sciences librarians. It is one of the key successes of our IAIMS efforts. WILLOW is now the primary interface to the online catalog and bibliographic databases campus-wide. WILLOW (via x-emulation software) runs on PCs, Macs, UNIX stations as well as X-terminals. A Z39.50-compliant Willow version is currently being tested. When it is completed WILLOW will, in fact, be capable of accessing virtually any Z39.50 compliant database anywhere on the Internet.

The BRS search software running on several RS6000's is used as the retrieval engine for a variety of bibliographic databases, including the Library's online catalog, Medline (all years), Psychological Abstracts, Grolier's Encyclopedia and INSPEC.

Medical Centers Information Systems (MCIS) has adopted the same set of network and software standards as the University. X-terminals are being deployed throughout the Medical Centers (UW Medical Center and Harborview Medical Center) in clinical areas as well as offices. WILLOW is the interface of choice for accessing bibliographic databases from clinical areas throughout the Medical Centers.

IMPLEMENTATION PLAN

The overall goal of our implementation process is to create a comprehensive, integrated information access and management network that will complement and enhance the clinical, research, educational and administrative effectiveness of the Health Sciences Center and its affiliated institutions and programs.

Eleven specific aims support our broad integration goal:

1. Establish organizational relationships that support and facilitate integrated access to health information, specifically embracing systems initiatives of the Schools, the Medical Centers, the Health Sciences Library and Information Center, the University Office of Computing and Communications, and other affiliated entities.

2. Expand the technical infrastructure, including the network and related services.

3. Promote access to relevant, high-quality databases, including image, full-text, bibliographic and numeric, in order to support effective clinical, research and educational decision making.

4. Create effective information retrieval and management interfaces and tools for quality clinical, research and educational decision making.

5. Promote faculty development in the application of effective information technology in research, education and clinical care.

6. Create educational programs and training opportunities in the effective use of information technology for health sciences students.

7. Develop an academic program to promote research, development and training in health sciences library and information management, clinical decision support, image management and integrated information systems design.

8. Ensure adequate core resources to support Health Sciences Center-wide information systems integration.

9. Identify, describe and, in partnership with other institutions, vendors and federal agencies, develop

approaches to information policy issues, including confidentiality, ownership, copyright and participatory use, as they relate to a variety of information formats.

10. Support the development of local, statewide, regional and national high-performance computing networks.

11. Evaluate and assess our accomplishments and shortcomings and share our findings with other institutions.

Three models provide the framework for and inform our implementation process: IDEAL (Integrated Databases for Enhancing Academic Learning), our educational model; MIND (Medical Information Networked Databases), the Medical Centers model for systems integration; and UWCARENET (UW Clinical, Administrative, Research and Education Navigation and Empowerment Tools).

UWCARENET

UWCARENET provides for the development of interface(s), tools and databases as well as a network server environment to deliver and/or direct users to appropriate information resources and databases. It addresses the need for a common user interface to all types of information, the need for reference database accessibility and the need for individual information management tools.

Specific UWCARENET projects include:

1. Extension of the Willow user interface to support access to full-text clinical reference databases, image databases, medical records.

2. Integration of the UMLS knowledge sources as a common vocabulary to Willow databases.

3. Development of UCARE, the health sciences extension of the UWIN/UW Gopher server for easy access to quality local as well as Internet-accessible health sciences databases.

4. Development of information management databases and tools for individual productivity, including export capabilities from WILLOW and UCARE databases, a public domain "cross-platform" reference manager and a simplified document request/delivery system.

CLINICAL DECISION SUPPORT

MIND is the system development strategy for the Medical Centers. MIND development is led by Medical Centers Information Systems (MCIS) in close coordination with health professionals from both Medical Centers and from the Health Sciences academic programs. The MIND strategy is to develop information resources in an environment of distributed computing and databases employing a foundation of common standards and protocols. MIND is designed to utilize and take advantage of University-wide standards, including ethernet, TCP/IP and X/MOTIF, thus ensuring integrated access to Medical Centers databases as well as a synergistic relationship with other IAIMS research and educational initiatives.

IAIMS clinical decision support projects include both concurrent decision support and outcomes analysis support. Clinical decision support projects include:

1. Development and delivery of a variety of commercially available clinical reference databases, such as Micromedex.

2. Development of specifications for a Willow interface to a prototype mini-medical record.

3. Creation of a Unified Institutional Data Dictionary (UIDD) to build consistent data definitions and cross-references across the various departmental databases. We will evaluate the UMLS knowledge sources as a potential structure for our UIDD development efforts.

4. Toolkit for Retrospective Decision Analysis. We believe it is not enough to develop a common interface to databases but that we need to provide tools to assist in the analysis of the data retrieved. The toolkit would include an integrated set of functions and tools which would permit clinicians and administrations to retrieve and analyze data from a variety of resources on the network (e.g., patient data, administrative data, external data, and the literature). Our prototype toolkit will focus on trauma patient data management.

IDEAL

IDEAL (Integrated Databases for Enhancing Academic Learning) is our model for the creation

of an integrated teaching and learning environment. It provides an environment for faculty to manage the learning experiences of students through access to information resources of all types (images, text, sound) as well as authoring tools. By using the academic authoring tools the instructor can construct assignments, didactic sessions, practice simulations and team-managed problem-based learning experiences. In addition, IDEAL is a student learning environment in which learners can monitor their own performance through self-evaluation, get extra help through branching to remedial exercises or follow their own interest through dynamic links to research databases for related information. Collaboration tools will promote group learning processes.

Specific IAIMS projects that will contribute to the realization of the IDEAL model include:

1. Faculty development program to increase the sophistication of faculty in the application of technology to access and retrieve information, to develop instructional materials, to evaluate student performance and to communicate with colleagues and students.

2. Image databases project to focus on the development of institutional file formats, indexing and access protocols in support of shared image database access on the network. Willow will be tested as the interface for access to resulting image databases.

3. Development of a prototype for integrated course authoring and student access software.

INFORMATION POLICY - ISSUES AND OPPORTUNITIES

IAIMS planners frequently say that technology is the least of our worries and that, in fact, the most thorny problems relate to information policy issues including confidentiality, copyright, participatory use (that is, use by specific user populations, e.g., medical students, and not others), and ownership. As we move into wide-spread integrated systems implementation, a host of information policy issues face us, not only internal issues but also vendor requirements. Each time we negotiate to purchase another database, we are faced with another set of vendor demands regarding how charges will be levied, limitations on who can use the database and how the contents can be used (e.g., restrictions on re-use). Image ownership is a particularly complex problem since, unlike MEDLINE, where the entire database is owned by the producer (NLM), images are often owned individually. And, unlike a bibliographic database which serves as a pointer to the end product, e.g., the article, image databases are composed of the "end products." As the images are aggregated into a database, for instance the Slice of Life Videodisk, what one can do with the individual images varies greatly. The challenge of balancing individual ownership and licenses with the desire to share information widely in a distributed environment is a formidable one and one in which the rules, not to mention the interpretation of the rules, are still to be written.

While the University of Washington, as an institution, has made a broad commitment to shared databases and electronic resources, a key component of our IAIMS implementation process will focus on the development of approaches to the broad information ownership and regulatory issues.

CONCLUSION

As an IAIMS implementation site, we hope that UW will serve as a useful model for other institutions, particularly large public institutions. The UW policy of creating software of general interest and utility (PINE, WILLOW) and making that software available to other academic institutions at no charge will continue throughout our IAIMS implementation efforts.

The University of Washington IAIMS effort has set an ambitious course for the future. The general agreement upon networking, hardware and graphical user interface standards provides us with a firm foundation for development of tools and databases that will enhance the quality and productivity of the UW Health Sciences Center as we prepare for the challenges of the next century.

Acknowledgements

Support for this work was provided, in part, by U.S. Public Health Service Grant No. LM05050 from the National Library of Medicine. Its contents are solely the responsibility of the author and do not necessarily represent the official views of NLM. Special thanks to the University of Washington IAIMS leadership, including Dr. James LoGerfo,

Debra Ketchell, Dr. Jim Barrett, and Dr. Rita Altamore.

References

[1]. Matheson NW, Cooper JAD. Academic information in the academic health sciences center: roles for the library in information management. *Journal of Medical Education* 57:Oct 1982, Part 2, 1-93.

[2]. Lindberg DAB. The IAIMS initiatives of NLM. Institutional planning for advanced information services. *J. Am. Soc. Info. Sci.* 39(2):105-106, 1988.

[3]. Ball MJ. Planning and implementing integrated information services. Integration and outreach: Integrated Academic Information Management Systems (IAIMS) at Maryland.

[4]. Lorenzi NM, Marks EB. University of Cincinnati Medical Center: Integrating Information. *Bull. Med. Libr. Assoc.* 76(3):231-236, 1988.

[5]. Gorry GA, Burger AM, Chaney RJ, Long KB, Tausk CM. A virtual notebook for biomedical work groups. *Bull. Med. Libr. Assoc.* 76(3):256-267, 1988.

[6]. Stead WW. Information management through integration of distributed resources. *Bull. Med. Libr. Assoc.* 76(3):242-247, 1988.

[7]. Roderer NK, Clayton PD. IAIMS at Columbia-Presbyterian Medical Center: accomplishments and challenges. *Bull. Med. Libr. Assoc.* 80(3):253-262, 1992.

[8]. Broering WC, Bagdoyan HE. The impact of IAIMS at Georgetown: strategies and outcomes. *Bull. Med. Libr. Assoc.* 80(3):263-275, 1992.

[9]. Fuller SS. Creating the future: IAIMS planning premises at the University of Washington. *Bull. Med. Libr. Assoc.* 80(3):288-293, 1992.

[10]. Ketchell DS, Fuller SS, Freedman MM, Lightfood EM. Collaborative development of a uniform graphical interface. *Proceedings of the Sixteenth Annual Symposium on Computer Applications in Medical Care*, 1992; 251-255.